Added Claim 25 more particularly defines the method of original Claim 7.

Claims 26 to 29 are directed to preferred embodiments of the composition, as exemplified in the specification and drawings.

No new matter has been introduced by the amendment.

REMARKS

Favorable reconsideration of this application is requested.

The invention relates to an alkali metal-containing niobate-based piezoelectric sintering material composition comprising:

a solid solution represented by a composition formula $ANbO_3$, wherein A is an alkali metal; and

at least on additive selected from the group consisting of Cu, Li and Ta, as well as to a method for its preparation.

The effect and purpose of the additive is to highly densify the material and to prevent the reduction of dielectric loss of an alkali metal-containing niobate so that excellent piezoelectric properties with good stability over time can be obtained. This is so factually demonstrated by the Examples and comparative evidence in the case.

With regard to the objections to the specification, and in order to clarify the language, the following is pointed out to the Examiner.

The niobate-based piezoelectric material comprises a solid solution represented by a composition formula $ANbO_3$, e.g., $Li_x(K_{1-y}Na_y)_{1-x}(Nb_{1-a}Ta_z)O_3$ with at least one additive selected from Cu, Li, and Ta. Cu, Li, or Ta added to the solid solution, $Li_x(K_{1-y}Na_y)_{1-x}$ $(Nb_{1-z}Ta_z)O_3$ functions mainly as a sintering auxiliary agent. In addition to the function as a sintering auxiliary agent, Cu also functions as a substitutional solid solublization agent in the

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solid solution crystals, as so disclosed in the specification.

In the resultant niobate-based piezoelectric material, the solid solution $ANbO_3$ contains at least one additive selected from Cu, Li, and Ta in a state being added, interstitially solid solubilized, or substitutionally solid solubilized thereto, or possibly in combination of the above states.

For this reason, the claims of the present invention recite the composition as "the solid solution represented by the composition formula + the additive," rather than representing the specific composition formula of the resultant composition itself. The amount of the additive is explicitly recited in the subordinate claims.

The claims stand rejected under 35 U.S.C. §102(b) or 103(a) as being unpatentable over Hofmeister (patent or article), Günter, Japan '589 or Henson.

Hofmeister relates to photo refractive crystals for use in optical systems. This clearly neither anticipates, nor makes obvious the claimed invention.

The photo refractive crystals of Hofmeister are formed from a flux prepared by mixing potassium carbonate, lithium carbonate, tantallum oxide, niobium oxide and appropriate dopant oxides, to form a solids mixture which are heated to form a flux. The crystals are then obtained by introducing a seed crystal into the flux and lowering the temperature.

No such crystals are claimed. Rather, the alkali metal-containing niobate based piezoelectric sintering material of the claims is formed by adding an additive powder containing at least one element selected from copper lithium and tantallum to a mixture of a niobate, blending these powders together, molding said blended powders and sintering the same to provide for a composition having piezoelectric properties.

The Hofmeister references thus clearly do not anticipate nor make obvious the

claimed invention.

Günter relates to a composition, for use in preparing a film, (preferably an epitactic film) comprising a solid solution of $KNbO_3$ and $KTaO_3$ forming a product of formula I

$$K_{1-y}M_yTa_{1-x}Nb_xO_3 \qquad (I)$$

in which M is a monovalent metal ion other than K^+ (dopant);

y=0.02 to 0.20 and

x=0.05 to 0.95.

Here again, no sintering material is involved, the niobate being obtained as crystals from a supersaturated solution thereof.

Similarly, neither the Japanese reference nor Henson relates to a piezoelectric material of the nature as claimed. They are drawn to a porcelain (Japanese reference) or ceramic (Henson) not evincing properties and characteristics as in the claims invention.

The claims distinguish over the references in the following unobvious and unexpected effects neither recognized nor taught by the art:

· Effect of Cu on $K_{1-x}Na_xNbO_3$: Cu acts as a sintering auxiliary

· Effect of Cu on stability of dielectric constant over time

· Cu improves piezoelectric constant (g31), electromechanical coupling factor, and mechanical quality factor (Qm), and reduces dielectric loss.

· Li, Ta solid solubilization improves mechanical quality factor (Qm), and reduces dielectric loss

· Li, Ta solid solubilization improves stability of dielectric constant over time

· By mapping Li and Ta as shown in Fig. 9(b), it is apparent that piezoelectric constant (g31) is improved more than two times (better than the conventionally expected ones)

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· Li, Ta solid solubilization improves electromechanical coupling factor more than one and a half times.

These effects clearly are not obvious from the art, within the meaning of 35 U.S.C. §103.

Specifically, also with regard to added Claims 26-29 the following is pointed out:

a) <u>Contents of Li and Ta</u>

As is apparent from Fig. 9(b), improved piezoelectric constants (d31) are obtained within the range where x=0 to 0.10 and z=0 to 0.40, exclusive of the following compositions: x=0 and z=0; x=0.08 to 0.10 and z=0; x=0.10 and z=0.20; x=0.10 and z=0.30; and x=0.08 to 0.10 and z=0.40.

As is apparent from Fig. 9(a), improved electromechanical coupling factors (kp) are obtained within the range where x=0 to 0.10 and z-0 to 0.40, exclusive of the following compositions: x=0 and z=0; x=0.06 to 0.10 and z=0; x=0.10 and z=0.10; x=0.08 to 0.10 and z=0.20; x=0 and z=0.30; x=0.08 to 0.10 and z-0.30; x=0 to 0.02 and z=0.40; and x=0.08 to 0.10 and z=0.40.

As is apparent from Fig. 10(c), dielectric loss (tanä) is desirably low within the range where x=0 to 0.20 and z=0 to 0.40 (note that x is up to 0.20), exclusive of the following compositions: x=0 and z=0; x=0.06 to 0.20 and z=0; and x=0.10 and z=0.10.

b) <u>Addition amount of Cu</u>

As is apparent from Tables 1 and 2, the amount of Cu is desirably 1 mol% of KNN or less. (The desirable amount is determined in view of improvement of piezoelectric constant (g31), dielectric loss, stability of dielectric loss over time, mechanical quality factor (Qm), and dielectric constant change relative to temperature.)

Copies of Figures 9(a), (b), and 10(c), highlighted to show the unobvious results, are

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attached for the Examiner's convenience.

Accordingly, withdrawal of the rejection of the claims under 35 U.S.C. §102 and 103 is requested.

With regard to the rejection of the claims under 35 U.S.C. §112, second paragraph, the clarification to the specification, as above set forth, is equally applicable to the reasons for this rejection.

Withdrawal of the rejection of the claims under 35 U.S.C. §112, second paragraph, thus is requested.

An Information Disclosure Statement is submitted herewith providing copies of the references cited and discussed at page 2 of the specification.

The typographical errors noted by the Examiner have been corrected.

Substitute Figures 6 and 7 are submitted herewith for the Examiner's approval. They correct the identification of KNN-LP.

It is submitted that this application is now in condition for allowance and which is solicited.

Respectfully submitted,

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